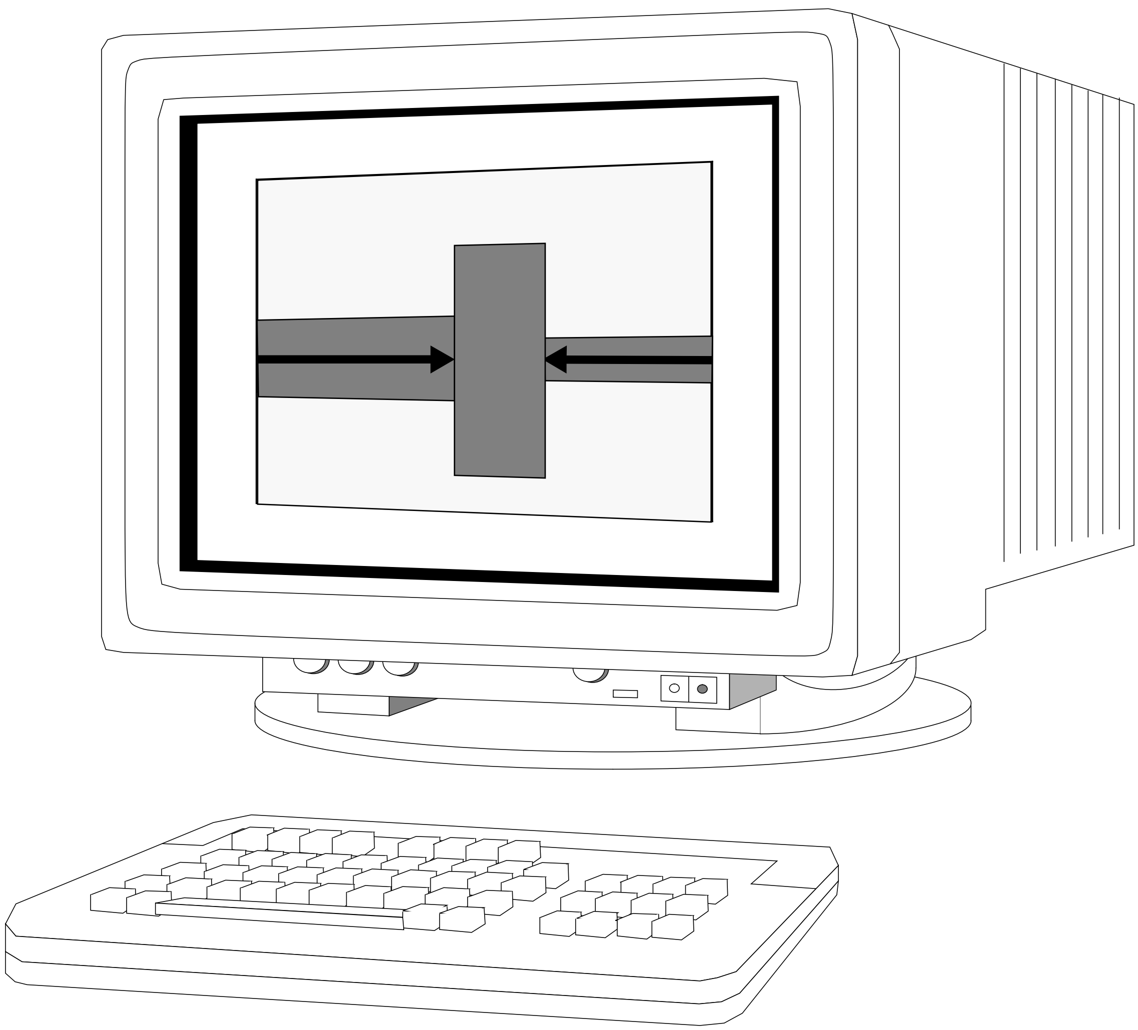
# Emvu User's Manual



# Emvu User's Manual

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## Release 2.4

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This publication is subject to change at any time and without notice. Any suggestions for improvements in this publication or the software it describes are welcome.

## Disclaimer of Warranties And Limitation of Liabilities

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# Chapter 1 Introduction

***Emvu*** is an X Window System, mouse based program used to view results from an ***em*** analysis as a color shaded plot. The colors can represent, for example, the magnitude of current density. By displaying a sequence of current density plots, for example, each one at a slightly different frequency, ***emvu*** can achieve real time animation.

Electromagnetic visualization, such as that provided by ***emvu***, provides a different kind of information as compared with the microwave tools we usually use. The standard microwave tools, such as the circuit theory based programs, and electromagnetic tools like ***em***, provide quantitative results. They can tell you if your circuit meets specifications and by how much.

In contrast, visualization tools are not primarily intended to give quantitative information. Rather, the information they provide is qualitative. For example, visualization does not tell you if your circuit meets specification, but they can answer questions like:

**Qualitative Question:** Why does my via have higher inductance than expected?

**Visualization Answer:** Because all the current flows down the nearest side of the via.

**Qualitative Question:** How can I reduce the inductance of the via?

**Visualization Answer:** By placing your via so that both sides of the via carry current.

**Qualitative Question:** Why doesn't any signal make it through my circuit?

**Visualization Answer:** Because, as the circuit was laid out, a capacitor was accidentally shorted to ground (easily seen due to the high current at the point of the short).

**Qualitative Question:** How do I estimate the electrical length around a “U-turn” bend?

**Visualization Answer:** The current flowing around a U-turn bend, as shown in a visualization plot, takes the shortest path with almost no current flowing on the outside edge. Thus the electrical length is about equal to the shortest path around the bend.

These, and many other questions which have already been answered, form the core of what promises to be an exciting new technology in microwave design. Questions and uses, not yet even a glimmer in an engineer’s eye, still remain.

***Emvu*** continues an important tradition at Sonnet, the elimination of software limits. Consistent with the Sonnet philosophy, ***emvu*** can display circuits with any number of ports, dielectric layers, and metal types. It also gives you the ability to change port characteristics and immediately see the effect on your circuit. In addition, ***emvu*** gives you the freedom to view your circuits using your own scale values or you may use ***emvu***’s autoscaling features. As an added feature, you may use ***emvu*** to see the variable size subsectioning used by ***em***.

# ♦ A Brief Overview

***Emvu*** is a visualization tool used to view circuits previously analyzed with ***em***. ***Em*** saves the resulting current density information in a file format ready for input to ***emvu***. Typically, the file ends with “.jxy”, where “j” stands for current density. The “xy” refers to the directions of the current (z-directed current is not shown).

The plots shown with ***emvu*** give you new insight into the workings of your circuit by showing you the “hot spots” and “cold spots” of your circuit. You may then use this information to improve your design and your design skills.

Figure 1 shows how ***emvu*** works with other programs from Sonnet, as well as programs from third parties.

# ♦ Plotting Considerations

There are a few ***emvu*** plotting considerations that you should be aware of:

1. The current densities plotted do not represent de-embedded data. Therefore, areas near any port include the effect of the port discontinuity.
2. Only x- and y-directed current are plotted. Z-directed current (from vias) is not displayed.
3. The triangular part of diagonal subsections is not shown. However, the current density leading up to the diagonal subsections is correct.

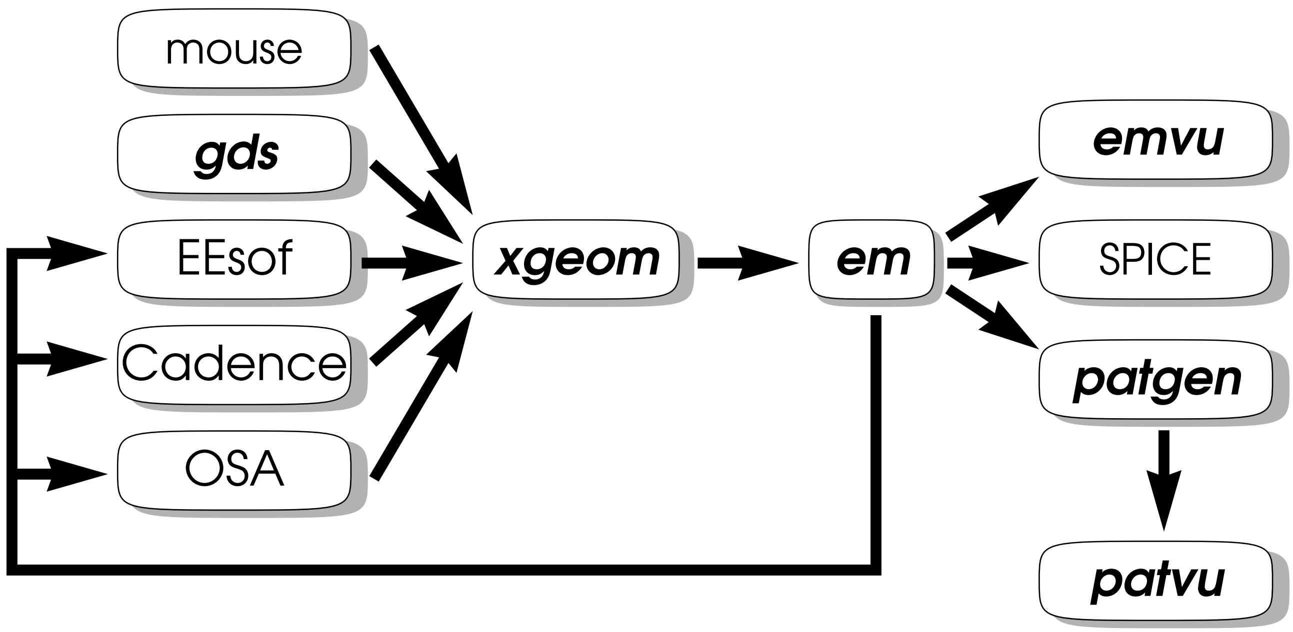


**Figure 1** Relationship of Sonnet programs. “Mouse” indicates manual capture or modification of circuit geometry. “SPICE” is any SPICE software. Other non-bold text indicates software developed by other companies which interfaces with Sonnet. Sonnet products are listed in bold. Arrows indicate data flow.

# ♦ Requirements

Because of the nature of the software*, **emvu*** requires a color monitor. Specifically, you need a non-static display supporting a minimum of eight planes. On MS-DOS systems, ***emvu*** uses 16 or 256 colors and requires a VGA or SVGA monitor. This is the only hardware requirement above that needed to run ***xgeom***.

# ♦ Enhancements in This Release

Release 2.4 provides several functionality enhancements. The enhancements are a direct result of suggestions our customers have taken the time to make. We thank you for doing so. We didn’t have a chance to implement all suggestions, but you may recognize one or more of your suggestions in the following list.

- The *View* command has been enhanced with a *Zoom* feature which allows you to zoom into a smaller section of the display to observe the current density in more detail.

- The previous release of ***emvu*** had the ability to probe the circuit with the mouse to determine the current density at any location. The present release displays the coordinates of the location along with the current density at that point.
- Several characteristics have been added to the port parameters. You may now specify or change the reactance, inductance, or capacitance of the ports in addition to the resistance, source voltage magnitude, and source phase.
- ***Emvu*** has a new menu called *Parameters* ⇒ *Response* that allows you to select the type of response presently displayed. In addition to the default of total current density, you may view the x-component or y-component of the current density as well as viewing the charge density of the circuit.
- The *Animate* feature has been expanded to allow you to select how ***emvu*** uses memory for animation. Normally, ***emvu*** uses the maximum amount of memory resulting in the fastest animation possible. If you are running out of memory, use *Animate* ⇒ *Memory* to reduce the amount of memory required.
- Several features of *Animate* have been moved or changed. The *Speed* feature has been renamed *Delay*. *Delay* is located under *Animate* ⇒ *Frequency* ⇒ *Options* to allow changing the delay between animation screens without reloading the animation data. A *Repeat* option has been added to allow continuous repetitions of the animation.
- PostScript printers are now supported using the *File* ⇒ *Print* menu.
- ***Emvu*** will now automatically use a default file extension of ".jxy" if a file extension is not specified after a file name. If a file extension is specified, ***emvu*** uses the one specified.

# ♦ Conventions Used in This Manual

The following section discusses conventions used in this manual. Familiarity with the use of X Window Systems such as Motif, OpenWindows, or DESQview/X is assumed. If not familiar with the X Window System, obtain documentation for your system describing the use of the X Window System. A half hour spent using the X Window System is more than adequate.

## ✧ *Emvu* Button Menus

***Emvu***'s functions are accessed by "pressing" the appropriate menu buttons. To "press" an ***emvu*** button on the main menu, use the mouse to position the cursor directly on the desired button. Press and hold down the left mouse button and a menu appears. Holding the mouse button down, drag the cursor down until the desired item is highlighted. Then release the button. If the button is released while the cursor is outside the menu, no action results. For example, move the mouse so that the cursor is on the *Parameters* button. Press (and hold down) the left mouse button. The ***emvu*** button is highlighted (changes color) and a menu appears. Notice that the cursor has changed its shape. To select a menu item, such as *Subsections*, move the cursor (mouse) down so that *Subsections* is highlighted and then release the left mouse button. If, for some reason, no item on the menu is wanted, just move the cursor off the menu so that no item is highlighted and then release the mouse button. Once a main menu item is selected, a new button menu is usually displayed.

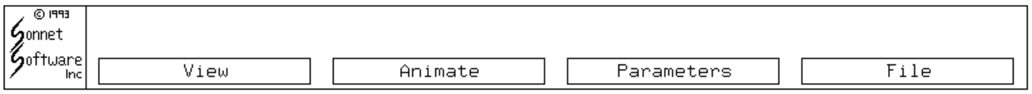


**Figure 2** The ***emvu*** Main Button Menu.

Please note that the main ***emvu*** button menu is the ONLY button menu which uses "hold and drag" (i.e., holding down the mouse button and moving it before releasing). All other button menus are "click and release". To "press" an ***emvu*** button on all remaining button menus, use the mouse to move the cursor to the desired menu button, then press and release the left mouse button.

Notice that some menu items have an ellipsis (...) after them. This means that this item calls another button menu. These menu items require more information before an action can take place. Other menu items (such as the *Subsections* option under the *Parameter* menu) have a word in angle brackets ("< >"). These items are toggles. Clicking on an item marked "<On>" turns that particular attribute off and clicking on an item marked "<Off>" turns that attribute on.

Most button menus have a *Done* or *Skip* button as the right most button. Clicking on this button returns you to the next higher menu level, eventually always ending in the main button menu.

Occasionally, keyboard input is required. In this case, an appropriate prompt appears on the button menu and anything you type appears there also. Pressing *Return* or the mouse button without typing anything leaves the present value of the parameter unchanged.

## ✧ Clicking on a Button

To click on a menu button, you should use the mouse to move the cursor to the desired menu button, then press and release the left mouse button.

## ✧ Describing Button Presses

In the rest of this manual, we describe accessing the menu items of ***emvu*** using a "pointer" description to illustrate selecting the desired menu buttons.

For example, *Parameters* ⇒ *Scale* ⇒ *Autoscale* means to move the cursor to the *Parameters* button in the main button menu, press (and hold down) the left mouse button, drag the cursor down the menu which appears until *Scale* is highlighted, and release the mouse button. When the new button menu appears, click on *Autoscale*.

### ✧ Shortcut Keys

Some menu buttons have a shortcut associated with them. These menu buttons can be "pressed" by typing the associated shortcut key. Shortcuts are shown in parentheses at the end of the name of the menu item. Typing the shortcut key has the same effect as "pressing" the menu button but you don't need to go through the menus. Most of the shortcut keys are "control" keys, i.e. you must first hold down the *Control* key, and then press the key. The "control" keys are abbreviated with a "^" symbol. Any time you see a "^" symbol before a letter, e.g., "^U", you should interpret this as meaning a control key. As an example, to type a Control-U (^U), hold down the *Control* key and press the *U* key. A list of the shortcut keys is found in the section "Keyboard Shortcuts" on page 29 of this manual.

## ♦ Using the Example Files

In the following chapters, we refer to several example files which are supplied with ***emvu***. To use these files, you must copy them into your directory. A utility called ***copyex*** has been provided with ***emvu*** which copies example files into your directory. To copy an example file, type in "copyex" followed by the file name. For example, to copy the example file "steps.geo", type:

**copyex steps.geo**

***Copyex*** copies the example file from the Sonnet example directory into your directory. If a file in your directory has the same name, ***copyex*** overwrites it with the original example file. This feature is useful if you modify an example file and want to restore the file to its original version.

## ♦ Organization of This Manual

Chapter 2 and Chapter 3 of this manual form a tutorial illustrating the use of ***emvu*** through examples. Chapter 4 forms a concise reference for ***emvu***'s functionality, suitable for use once one has a working knowledge of the program. The tutorial section of the manual requires about an hour to complete.

# Chapter 2 An *Emvu* Example

The following sections describe an example of using ***emvu***.

## ♦ Getting Started

For Unix systems, log into your account. At this point, system specific actions may be required which are not described here. If needed, consult your system administrator.

Now make and change to a new directory, type:

**mkdir test**

**cd test**

Next, if the X Window System is not already automatically running, start it. For Unix systems, a (system specific) command like “xstart”, “x11start”,”xinit”, “openwin” or “motif” should do it. For MS-DOS systems, “dvx” should start it. If not, again, seek assistance from another user or the system administrator.

There are several window systems, which provide a friendly “look and feel”, built on-top of X. These include Motif, OpenWindows and DESQview/X. Not included are proprietary window systems such as Sun View, which is, or will soon be, obsolete.

# ♦ Creating an *Emvu* File

For our example, we use the cascaded steps example from the ***Em*** **User's Manual**. First, copy the files "ctl.an" and "steps_sy.geo" from the Sonnet example directory by typing:

**copyex ctl.an**

**copyex steps_sy .geo**

The "ctl.an" file tells ***em*** to do the analysis at a single frequency of 10.0 GHz. The file "steps_sy.geo" is the geometry file for this example. We will be creating a current density file called "steps_sy.jxy".

Create the file "steps_sy.jxy" by typing:

**em -mvj steps_sy**

This command runs ***em*** and creates an S-parameter file called "steps_sy.nd" and a current density file called "steps_sy.jxy". The "-j" option tells ***em*** to create a current density file for use by ***emvu*** *in addition to* the regular non-de-embedded response (".nd") file. If you do not want the file to be called "steps_sy.jxy" you may specify the name on the command line. If the file specified ends in ".jxy", ***em*** uses this name as the current density file. For example, the command,

**em -mv steps_sy .geo animate.jxy**

would create a current density file called "animate.jxy".

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☞ **NOTE**

If you specify a current density file on the command line, you don't need to specify the "-j" option. If you specify a current density file that already exists, ***Em*** saves the existing file with a file extension of ".jxb" before creating the new file.

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# ♦ Running the *Emvu* Program

Once the X Window System is started, you can start ***emvu***, provided it has been properly installed (as described in the **Sonnet Installation Manual**). For our example, type the following command:

**emvu steps_sy.jxy**

When you press the *Return* key, ***emvu*** starts loading the file “steps_sy.jxy”.

Depending upon the speed of your computer, this may happen immediately, or you may have to wait a short time. The cursor symbol changes to a clock while ***emvu*** is loading in the data.

On your screen, a color plot of your circuit is shown (similar to Figure 3). Red areas represent high current density, and blue areas represent low current density. A scale is shown on the left of the window which defines the values of each color. To see a current density value, click on any point on your circuit. The current density value (in amps/meter) at the point that you clicked is shown at the top of your window along with the coordinates of the location.

# ♦ The *Emvu* Command Line

The command that you just typed to run ***emvu*** was:

**emvu steps_sy .jxy**

This brought up the ***emvu*** window and then loaded the file called “steps_sy.jxy”. The “.jxy” at the end of the file name indicates a Current Density File which is generated as output by ***em***. All information about the current density of your circuit is stored by ***em*** in this file. The file name is not required to end in “.jxy”, but it is recommended. If you do not specify a file extension, ***emvu*** automatically uses a default extension of “.jxy”. For the above example, you could have also typed:

**emvu steps_sy**

There are numerous command line options available for ***emvu***. They can be used to set, for example, window size and location, background and foreground colors, etc. For example, the -noRestoreColorMap option can be used to prevent the flicker and color changes which may occur when moving the cursor outside the ***emvu*** window. All of the options are detailed in Appendix I, "The Emvu Command Line".

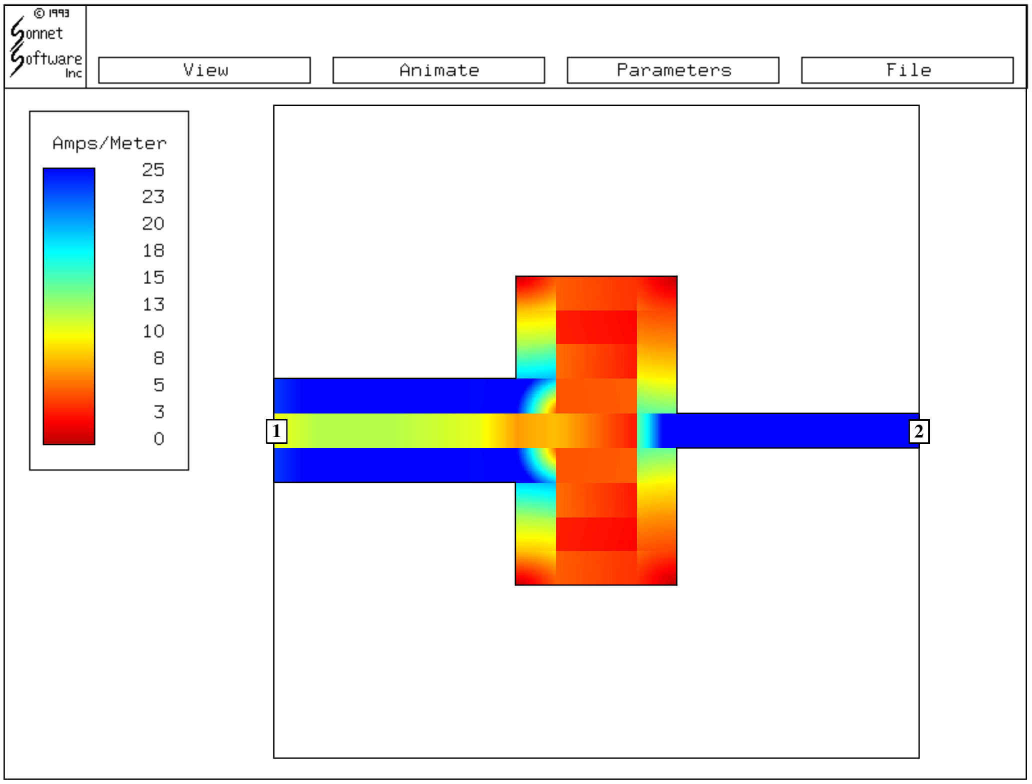


**Figure 3** The ***emvu*** window showing the current density of the example circuit.

# ♦ What You are Seeing

The color plot shows the current distribution of your circuit as analyzed by ***em***. The magnitude of the current density, in amps/meter is calculated for each subsection and then plotted using the color scale shown in the left part of the ***emvu*** window.

In our example, notice the red “bands” at the edge of the line connected to port 1. This shows the classical microstrip current distribution where the current “hugs” the edge. Areas where the color changes abruptly represent boundaries between subsections.

# ♦ Changing the Scale

The values for each of the colors of your plot are shown on the scale at the left of your ***emvu*** window. For our example, values between approximately 23 amps/meter and 25 amps/meter are shown in varying shades of red. Values of approximately 18 amps/meter are shown in yellow, etc. Values larger than the maximum value of the scale are shown in the brightest red and values less than the minimum are shown in the darkest blue.

When ***emvu*** first starts, it chooses a reasonable scale based on the actual values of your data. You may find, however, that your area of interest is all one color and conveys little intuitive information. To make your plot more useable, you should change the scale.

Select *Parameters* ⇒ *Scale* to change the scale. The button menu (see Figure 4) then appears, replacing the main button menu.

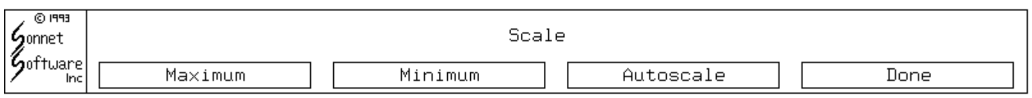


**Figure 4** The *Scale* button menu allows specification of the scale used for plotting.

To illustrate the use of the scale selections, click on the *Maximum* button. The button menu is then replaced by a prompt asking for the desired maximum scale value for plotting. The prompt also informs you of the present value if applicable.

For this example, we want a maximum value of 20 amps/meter. Do this by typing the number "20" and pressing the *Return* key. The mouse location is not critical.

Just pressing *Return* without typing anything else causes the present value to remain unchanged. This is typical of ***emvu*** prompts.

After the prompt is answered, the button panel returns to the original scale display, and the plot is redrawn with the new scale. Notice that the plot has more red in it now. Do not click on *Done* yet. We must still talk about the *Autoscale* button.

# ♦ Autoscaling

You may specify the plotting scale two different ways: by specifying minimum and maximum values, or by having ***emvu*** choose a scale for you. In the above section, the "maximum" value was specified.

You may have ***emvu*** "autoscale" your plot. This is most useful in getting starting values for a plot and for animating (discussed later). To do this, you need to specify an autoscale factor. When this option is used, first ***emvu*** calculates the standard deviation and average current density over the entire metal region on the present level. It then sets the maximum scale according to the following formula:

maximum = average + (autoscale factor) * (standard deviation)

For example, entering in an autoscale factor of "3" sets the maximum value to the average plus 3 standard deviations. The minimum scale value is set to zero.

***Emvu*** uses an autoscale factor of 1 as the default. This value is used when ***emvu*** first starts up and when a new file is loaded in.

For our example, click on *Autoscale*, type in a value of "1" and press *Return*. This changes the plot back to it's original scale. Now click on *Done* to return to the main button menu.

# ♦ Zooming

You can zoom into a particular area of your circuit by using *View* ⇒ *Zoom In*. After selecting the option, the cursor, when in the main window, changes to indicate that ***emvu*** is waiting for you to tell it where you want to zoom. Move the mouse to the upper left corner of the region you want magnified and press the left mouse button. Holding it down, drag the cursor to the desired lower right corner and release the button. The specified region is expanded to fill the screen. You can go back to the previous zoomed region by clicking the middle mouse button without moving the mouse. To reset the view so that the entire substrate surface is visible on the screen, double click the middle button. To double click, quickly click twice on the mouse button.

The zoom button, the middle button on the mouse, may also be used to magnify a specific area in the circuit. Using the mouse, move the cursor to the upper left corner of the region you want magnified, then press the middle mouse button. Holding it down, drag the cursor to the lower right corner, then release the button. The specified region is expanded to fill the screen. Please note that you may start in any corner of the region when specifying a zoom window. You may also type ^Z (Control-Z) to reset the view and ^Y to toggle to the previous view.

Practice using both methods of zooming to become familiar with them.

# ♦ Changing Port Values

***Emvu*** allows you change the characteristics of any or all ports. Select *Parameters* ⇒ *Ports*. A new menu appears (see Figure 5).

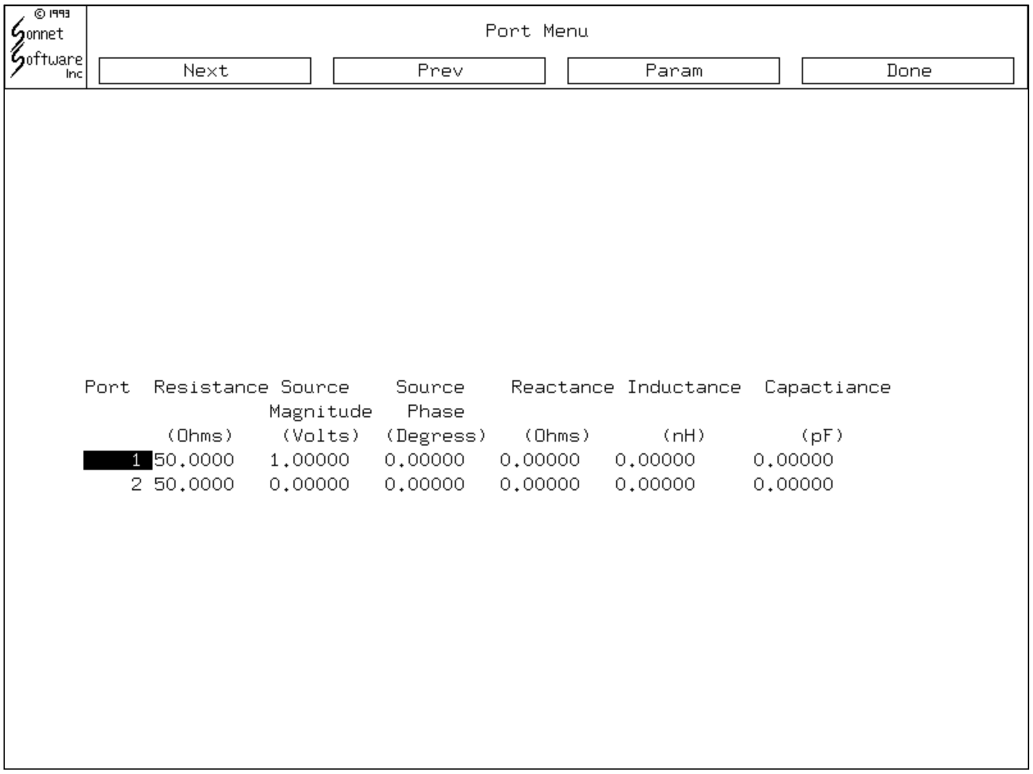


**Figure 5** The Port menu allows you to change the characteristics of each port.

You may change the resistance, source voltage magnitude, source phase, reactance, inductance, or capacitance of the port by clicking on the value that you want to change and typing in the new value.

For our example, let’s change the resistance of port 2 to 10,000 ohms. To do this, click on the “50.000” for port 2 and enter “10000”. Now click on *Done* to get a new plot. Notice that the current near port 2 is low (blue). This is because the 10,000 ohms is causing port 2 to act like an open circuit.

If you wish to change all of the characteristics of a port at once, click on the port number or use the *Next* and *Previous* buttons to highlight the port that you want to change. Then click on *Param*. You are prompted for all new values of that port. To keep the values the same, just press the *Return* key.

# ♦ Finishing the *Emvu* Program

This is the end of the first example of using ***emvu***. To stop the program, select *File* ⇒ *Quit.*

# Chapter 3 Animation

The previous example was analyzed at only one frequency point. In the next example, we analyze the circuit at many points and exercise the animation features of ***emvu***.

To do an animation, ***emvu*** takes a picture of your circuit at each frequency point and links the pictures together to form a "movie". This allows you to see, at a glance, how your response changes with frequency, giving you insight into the properties of your circuit.

# ♦ Starting the Animation Example

First we need to analyze a circuit at multiple frequency points. Let's use the same cascaded steps file from the previous example and analyze it from 10 GHz to 25 GHz. To do this, edit the file called "ctl.an" so that it looks like Figure 6. For Unix systems, use an editor like the "vi" editor. For MS-DOS systems, use an appropriate editor such as the MS-DOS Edit command.

```
VER 2.4
GHZ
FRE 15 25 1
```

**Figure 6** The "ctl.an" file needed for the next example.

We will create a new ".jxy" current density file called "animate.jxy". Analyze the circuit at the new frequency points by typing:

**em -mv steps_sy.geo steps_sy.nd animate.jxy**

Notice that we don't need to type the "-j" option since we specified a current density file ("animate.jxy") on the command line. If the file already exists, the old version of "animate.jxy" will be saved in a file called "animate.jxb".

When this is finished, call up ***emvu*** by typing:

**emvu animate**

As the new current density file is loaded in, your cursor changes to a clock symbol. When the file has finished loading, your cursor changes back to normal, and the new current density plot is displayed at the lowest frequency (in this case 15 GHz).

# ♦ The Frequency Menu

You may now look at other frequencies. Select *Parameters* ⇒ *Frequency.* A new button menu appears (Figure 7). Click on *Next* or *Previous* to manually sweep through the frequencies. Click on *Last* to view the highest frequency. If you wish to look at a particular frequency, click on *Value* and type in the new frequency. If the frequency that you typed does not exist, the closest frequency value is displayed. Click on *Done* to exit this menu.

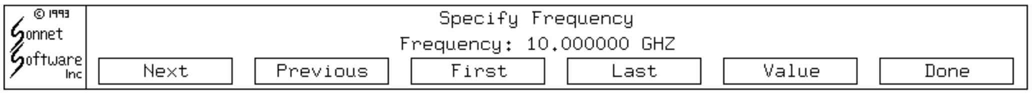


**Figure 7** The Frequency button menu allows you to change the frequency.

**NOTE**

When using the “Autoscale” feature, the scale automatically changes at each frequency point.

# ♦ The Animation Menu

A smoother way to sweep through your frequencies is to use the “animation” feature of ***emvu***. Select *Animate ⇒ Frequency.* Your cursor changes to a clock symbol while ***emvu*** is loading the animation data. A new button menu appears when the loading is complete (see Figure 8).

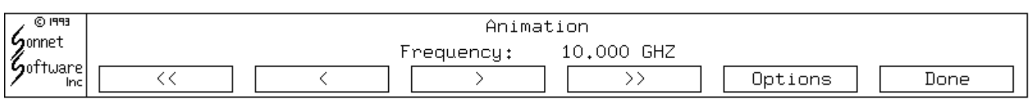


**Figure 8** The Animation button menu allows you to sweep through your frequencies automatically.

If you run out of memory while loading the animation data, see "Running Out of Memory" on page 24 for suggestions on conserving memory.

The animation menu allows you to step through different frequencies one at a time or to show a “movie” by doing a continuous frequency sweep.

When the animation menu first comes up, the first frequency is displayed. Click on “>” to display the next frequency. To view the previous frequency, click on “<“. To do a frequency sweep, click on “>>” to go forward and “<<”to go backward.

For our example, click on “>>” and notice how the plot changes with frequency especially at higher frequencies.

The animation uses the present parameter settings as set by the Parameters menu. When using the “Autoscale” feature, each frame is rescaled according to the autoscale factor entered. The scale automatically changes with each frequency point.

Click on *Options* if you want to change the delay between animation screens or change the animation to continuously repeat the cycle. The default delay is zero which provides the fastest animation. To change the delay, click on *Delay* and type in a value for the delay and press the *Return* key. To change the delay to 1/2 second, enter a value of 0.5 for the delay. Try several different delays to see the change in the animation.

To continuously cycle through the animation, click on *Options* and then click on *Repeat*. Click on the *Yes* button to select the repeat mode. After selecting repeat, the animation continuously cycles through the frequencies when you click on either “<<“ or “>>”. To stop the animation, press the mouse button or any key on the keyboard. To stop further repetitions, click on *Options*, *Repeat*, and then *No*.

Click on *Done* to finish animating. The main button menu appears again.

# ♦ Finishing the Animation Example

This is the end of the second example and the tutorial of using ***emvu***. To stop the program, select *File* ⇒ *Quit.* The next chapter contains a detailed description of ***emvu***’s functionality.

# Chapter 4 *Emvu* Function Reference

This section contains a brief, yet detailed description of ***emvu***'s functionality. It assumes you have read the previous tutorial and understand ***emvu***'s basic framework and purpose. Details on ***emvu***'s command line can be found in Appendix I, "The Emvu Command Line".

# ♦ The Mouse

***Emvu*** uses the left and middle mouse buttons (See Figure 9). The right mouse button is not used by ***emvu***.

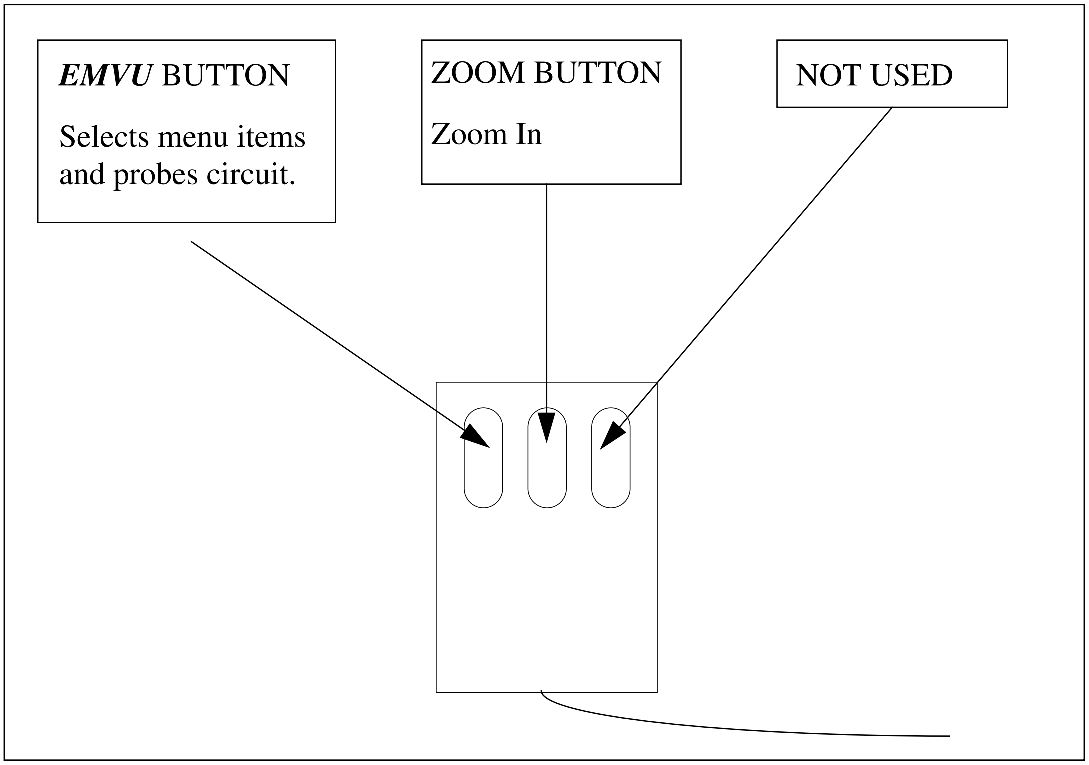


**Figure 9** ***Emvu*** uses the left and middle mouse buttons.

# ♦ Probing Your Circuit

You can find out what the current density is at any location in your circuit by "probing" your circuit. To do this, first make sure that you are in the main button menu. Now, click the left mouse button at the location on your circuit that you wish to probe. The value is displayed at the top of your ***emvu*** window along with the coordinates of the point you selected. Notice that if you hold down the left mouse button while moving ("dragging") the mouse, the values displayed are continuously updated.

# ♦ Zoom Button

The zoom button, the middle button on the mouse, may be used to magnify a specific area in the circuit. Using the mouse, move the cursor to the upper left corner of the region you want magnified, then press the middle mouse button. Holding it down, drag the cursor to the lower right corner, then release the button. The specified region is expanded to fill the screen. Please note that you may start in any corner of the region when specifying a zoom window. You can go back to the previous zoomed region by clicking the middle mouse button without moving the mouse. To reset the view so that the entire substrate surface is visible on the screen, double click the middle button. To double click, quickly click twice on the mouse button.

You may also type ^Z (Control-Z) to reset the view and ^Y to toggle to the previous view.

On some computers, due to timing problems, a double click may be interrupted as two single clicks and does not do a reset. If you experience this problem, you may use the ^Z key instead.

Computers with a two button mouse, are usually configured so that pressing both the right and left buttons at the same time is the same as pressing the middle button on a three button mouse. If this does not work, use *View ⇒ Zoom In* for the zoom function. See section "Menu: View - Zoom In" on page 22.

Please note that the zoom button is disabled while *Animate ⇒ Frequency* is selected. You must zoom in *prior* to selecting *Animate ⇒ Frequency.*

# ♦ *Emvu* Functions

Each function is described in the following sections. You may want to experiment with an example file such as “raystub.jxy”. To copy the example file into your test directory, type:

**copyex raystub.jxy**

Next, run ***emvu*** by typing:

**emvu raystub**

# ♦ The View Menu Button

The View menu options allow you to change how information is presented on the display.

### ✧ Menu: View – Zoom In

You can zoom into a particular area of your circuit by using *View ⇒ Zoom In*. After selecting the option, the cursor, when in the main window, changes to indicate that ***emvu*** is waiting for you to tell it where you want to zoom. Move the mouse to the upper left corner of the region you want magnified and press the left mouse button. Holding it down, drag the cursor to the desired lower right corner and release the button. The specified region is expanded to fill the screen.

You may also use the zoom button (middle mouse button on most computers) as a shortcut for *View ⇒ Zoom In*. See the section "Zoom Button" on page 21 for more details.

### ✧ Menu: View – Prev. View

*View ⇒ Prev. View* allows you to toggle between the present view and the previous view. As a shortcut, you can type ^Y or click the middle mouse button to toggle to the previous view.

### ✧ Menu: View – Full View

*View ⇒ Full View* resets the area displayed so that the entire substrate and circuit are visible on the available screen. As a shortcut, you can type ^Z to reset the view.

### ✧ Menu: View - Redraw

Use *View ⇒ Redraw* to redraw the ***emvu*** window.

## ♦ The Animate Menu Button

### ✧ Menu: Animate - Frequency

Use *Animate ⇒ Frequency* to load in the animation data. This may take a while for circuits analyzed at many frequencies. For runs with many frequencies, you may want to use a smaller window. This reduces the memory requirements, speeds up the loading process, and gives you a smoother animation. To do this, resize your window *prior* to selecting *Animate ⇒ Frequency.* The animation uses the present parameter settings as set by the Parameters menu.

The cursor changes to a clock while ***emvu*** is loading the animation data. When the load is complete, the cursor changes back and a new animation menu is displayed.

The animation menu allows you to step through different frequencies one at a time or to show a “movie” by doing a continuous frequency sweep.

When the animation menu first comes up, the first frequency is displayed. Click on ">" and the next frequency is displayed. To view the previous frequency, click on "<". To do a frequency sweep, click on ">>" to go forward and "<<" to go backward.

Use *Animate* ⇒ *Frequency* ⇒ *Options* ⇒ *Delay* to change the time that each frame is displayed in seconds. The default setting is "0" which corresponds to the shortest delay. Higher numbers result in a slower animation. Reasonable values range from 0 to about 5 seconds.

Use *Animate* ⇒ *Frequency* ⇒ *Options* ⇒ *Repeat* to repeat the animation cycle. Click on the *Yes* button to select the repeat mode. After selecting repeat, the animation continuously cycles through the frequencies when you click on either "<<" or ">>". To stop the animation, press any key on the keyboard. Notice that the mouse will not stop the repetitions. To stop further repetitions, click on *Options*, *Repeat*, and then *No*. Click on *Done* when you are finished animating.

---

**NOTE**

When the scale is set using the "Autoscale" option, each frame of the animation is rescaled. To animate with a constant scale, use *Parameters* ⇒ *Scale* ⇒ *Maximum* or *Parameters* ⇒ *Scale* ⇒ *Minimum*.

---

## ✧ Menu: Animate - Memory

Use *Animate* ⇒ *Memory* to select how ***emvu*** uses memory for animation. Normally, ***emvu*** uses the maximum amount of memory resulting in the fastest animation possible. You should only change this feature if you are running out of memory. The display shows the three memory options as well as which option is presently selected. Click on the desired option and then click on *Done*.

*High Memory Usage* generates all of the necessary data for each frequency plot in memory creating the fastest animation possible. This is the default option. Use this option unless you are running out of memory.

*Medium Memory Usage* reduces memory requirements by generating some of the plotting information only when it is needed. Use this option if you are running out of memory when using maximum memory. When using this option, the animation will be slower due to the additional computational time required during the animation.

*Low Memory Usage* uses the minimum amount of memory possible by only generating one frequency plot at a time in memory. Please note that selecting this option results in the slowest animation. Use this option only if you still run out of memory when using the medium memory option.

## ✧ Running Out of Memory

If you find that you are running out of memory during animation, here are some suggestions for decreasing your memory usage:

1. Reduce the size of your ***emvu*** window *prior* to selecting *Animate ⇒ Frequency*. Memory usage is a strong function of the size of your window. Resizing the window *after* using *Animate ⇒ Frequency* has no effect on memory usage.

2. Select *Animate ⇒ Memory* to select how ***emvu*** uses memory for animation. Normally, ***emvu*** uses the maximum amount of memory resulting in the fastest animation possible. If you are running out of memory, select *Medium Memory Usage* to reduce the amount of memory used. If you're still running out of memory, select *Low Memory Usage* to use the minimum amount of memory possible. Please note that selecting either option slows down the animation with *Low Memory Usage* being the slowest. See the previous section for a complete description of *Animate ⇒ Memory*.

3. Reduce the number of frequencies analyzed in ***em***. This reduces the amount of memory needed for animation.

4. For UNIX systems, check for other processes using memory. Terminating other processes makes more memory available for animation. See your UNIX documentation on the "ps" command.

# ♦ The Parameters Menu Button

The Parameters menu button allows specification of the frequency, scale, level, color map, response, and ports. It also allows viewing of the subsections to be turned on or off. When a parameter is changed, the plot is updated immediately to reflect the changes. Use *All* to change multiple parameters at a time.

## ✧ Menu: Parameters - Frequency

*Parameters ⇒ Frequency* changes the frequency that is presently displayed. You may step through the frequencies by using *Next* and *Previous* or you may go to the first or last frequency by clicking on *First* or *Last* respectively. Click on *Value* to type in a frequency directly. If the frequency typed in does not exist, the nearest existing frequency is chosen. Click on *Done* to return to the main menu.

## ✧ Menu: Parameters - Response

*Parameters* ⇒ *Response* allows you to select the type of response presently displayed. In addition to the default of total current density, you may view the x-component or y-component of the current density as well as viewing the charge density of the circuit. The response presently selected is displayed on the screen. Click on *JXY Mag* to view the total current density. Click on *JX Mag* to view only the x-component of the current density. Click on *JY Mag* to view the y-component of the current density. Click on *Charge* to view the charge density of the circuit. In each case, the display is redrawn with the selected response. Click on *Done* to return to the main menu.

## ✧ Menu: Parameters - Scale

*Parameters* ⇒ *Scale* changes the scale of the plot. The present settings are shown on the side of the window next to the color strip. Click on *Maximum* and/or *Minimum* to change the maximum and minimum values of the scale. Click on *Autoscale* to get a good starting value for the scale. The initial scale when ***emvu*** is started is set to an autoscale factor of 1.

---

☞ **NOTE**

The autoscale factor entered changes the minimum and maximum values for the scale. Choose either a *Maximum* and *Minimum* setting or an *Autoscale* setting.

---

## ✧ Menu: Parameters - Levels

Select *Parameters ⇒ Levels* to change the level that is displayed (see Figure 10). The levels are numbered starting with 0 for the uppermost and working down. As a shortcut, you can type ^U to move up one level and ^D to move down one level. To type ^U (Control-U), hold down the *Control* key and press the *U* key. Also, on many computers, the *up arrow* and *down arrow* keys function the same as ^U and ^D.

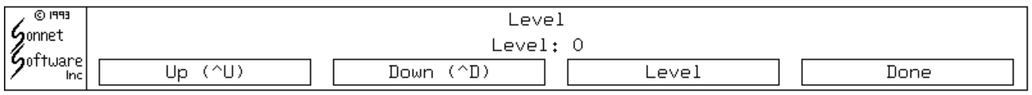


**Figure 10** The Level button menu allows you to move from one level to another.

## ✧ Menu: Parameters - Ports

*Parameters ⇒ Ports* displays the present values of port parameters. When you start ***emvu*** or load a new current density file, Port 1 defaults to a 1 volt source and all other ports default to loads (0 volts). All other parameters are read from the current density file. If you didn't specify any port parameters in ***xgeom***, all ports default to 50 ohms.

To change a value, click on the value that you wish to change and type in the new value. For example, to change the source from port 1 (default) to port 2, click on the value "1.000" for port 1 and change it to 0 volts. Then change the voltage of port 2 from 0 volts to 1 volt. To change all of the values for a port, click on that port number, or click on *Next* and *Prev* until the appropriate port is highlighted. Then click on *Param* and you are prompted for new values. Press the *Return* key to leave a value unchanged.

## ✧ Menu: Parameters - Subsections

*Parameters ⇒ Subsections* toggles the display to show the subsections of your circuit as analyzed by ***em***. Click on *Subsections <Off>* to toggle the subsections from "off" to "on". Remember, when your circuit has been analyzed with symmetry, only half of your circuit is subsectioned.

## ✧ Menu: Parameters - Color Map

*Parameters ⇒ Color Map* allows you to install alternate color maps. There are two choices: color (default), and gray.

### ✧ Menu: Parameters - All

*Parameters* ⇒ *All* shows the present settings of all parameters and allows you to modify any or all of them (see Figure 11). To change a value, click on the value that you want to change and type in the new value. Click on *Done* and ***emvu*** redraws the plot with the new changes.

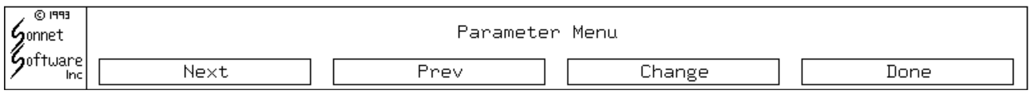


**Figure 11** Select *Parameters* ⇒ *All* to obtain the parameter menu. Any parameter may be modified through this menu.

Since there are too many port parameters to fit on one line, port information must be changed via a second menu. To change port parameters, click on the word “Ports” and the port menu appears. After making the desired changes to the port parameters, click on *Done* to return to the parameter menu.

## ♦ The File Menu Button

### ✧ Menu: File - Load

Select *File* ⇒ *Load* to load a file in from disk. ***Emvu*** asks for the file name and then loads in this file from the default directory. ***Emvu*** automatically uses a default file extension of “.jxy” if a file extension is not specified after the file name. If you do not know the name of the file, simply open a window and use the appropriate command to list the directory files. You can of course specify full path names or relative path names.

### ✧ Menu: File - Print

Select *File* ⇒ *Print* to print the plot presently displayed on the screen. ***Emvu*** can send the output to a printer or a file. Select *Printer* to send the output to the printer or to specify the printer. Select *File* to send the output to a file or to specify the file name. ***Emvu*** generates a PostScript file for printing or storing.

***Emvu*** allows several options for generating a printout. To change the orientation of the plot, click on *<Landscape>*. This changes the orientation to *<Portrait>*. Click on *<Portrait>* to change the plot back to *<LandScape>*. Click on *Options* to change or view the printing options (see below). When you have set all of the appropriate options, click on *Print* to print the data to the selected destination. If you selected *File* ⇒ *Print* by mistake, click on *Cancel* to return to the main button menu.

☆ *File* ⇒ *Print* ⇒ *Options* ⇒ *Size*:

Use this function to change the size of your printout. Click on the desired page size for the printout. Changing the page size resets all margins to the defaults. ***Emvu*** automatically switches to the appropriate units (inches or mm).

**Table 1: Page sizes**

| Page Size | Dimensions |
|---|---|
| *USLetter* | 8.5 x 11.0 inches |
| *USLegal* | 8.5 x 14.0 inches |
| *A4-Metric* | 210 x 297 mm |
| *B5* | 182 x 257 mm |
| *Customized* | User-defined |

☆ *File* ⇒ *Print* ⇒ *Options* ⇒ *Margins*:

Use this function to select the margins for the page. The defaults are one inch or 25 mm depending on which units are selected. Note that changing the page size resets all margins. Be sure to select your page size *before* changing the margins. Click on *Left* or *Right* to change the left or right margins respectively. Click on *Top* or *Bottom* to change the top or bottom margins respectively. Click on *Done* to return to the *File* ⇒ *Print* ⇒ *Options* menu.

☆ *File* ⇒ *Print* ⇒ *Options* ⇒ *<Inches>*:

This function selects the units for the dimensions of the page. Clicking on this option toggles the units between *<mm>* (millimeters) and *<Inches>*.

☆ *File* ⇒ *Print* ⇒ *Options* ⇒ *<Gray>*:

Use this function to change to a color plot. You must have a color printer to use this function. Clicking on this option toggles the option between *<Color>* and *<Gray>*.

☆ *File ⇒ Print ⇒ Options ⇒ <Final>*:

Use this function to select a draft image plot. A draft plot prints faster allowing you to quickly check the results. It may also be necessary to select a draft plot if the final print file is too large. Clicking on this option toggles the option between *<Draft>* and *<Final>*.

☆ *File ⇒ Print ⇒ Options ⇒ Done*:

Click on *Done* to return to the *File ⇒ Print* menu.

### ✧ Menu: File - Directory

Select this option to change the default directory where ***emvu*** stores and loads in the ".jxy" files. As part of the menu, the default directory is displayed. To change the default directory, type in the full path or a relative path to the new directory.

### ✧ Menu: File - Quit

Use *File ⇒ Quit* to exit ***emvu***.

## ♦ Keyboard Shortcuts

The table below describes the keyboard shortcuts available with ***emvu***. These functions may also be implemented by the menu. The shortcut keys are "control" keys, abbreviated with a "^" symbol. As an example, to type a Control-U (^U), hold down the *Control* key and press the *U* key.

| KEY | MEANING |
|---|---|
| **^D** | Move down one level |
| **^U** | Move up one level |
| **^Y** | Display the previous view |
| **^Z** | Display the full view |

Also, on many computers, the *up arrow* and *down arrow* keys function the same as ^U and ^D.

# Menu Summary

| View | Animate | Parameters | File |
|---|---|---|---|
| Zoom In | Frequency... | Frequency... | Load... |
| Prev. View | Memory... | Scale... | Print... |
| Full View | | Levels... | Directory... |
| Redraw | | Ports... | Quit |
| | | Subsections <On> | |
| | | Response... | |
| | | Color Map... | |
| | | All... | |

**Figure 12** Chart of ***emvu***'s menu options.

# Appendix I The *Emvu* Command Line

Run ***emvu*** by typing “emvu <options> <file-name>”. Options may appear after the file name. A file name ending in “.jxy” is recommended.

Most of the usual X Window System command line options are available. For example, to run ***emvu*** on one computer while using the display, keyboard and mouse of another computer (node name, say, “galaxy”), type:

**emvu -display galaxy:0**

***Emvu*** also looks in all the usual places for the X Window System defaults.

***Emvu*** options are as follows (associated resource keywords are in parentheses):

**-background <color>** (*background) Sets the background color.

**-backing** (*backing: yes) Uses backing store, if supported by display. This provides faster re-draw in exchange for larger memory requirements. Unless modified, default is no use of backing store.

**-bd <color>** (*borderColor) Sets color of main window border.

**-bg <color>** Same as -background.

**-borderwidth <x>** (*borderWidth) Sets main window border width to x pixels if allowed by the window manager.

| | |
|---|---|
| **-bordercolor <color>** | Same as -bd. |
| **-bw <x>** | Same as -borderwidth. |
| **-display <name>** | (*display) Sets display for input/output. For example: -display galaxy:0. |
| **-fg <color>** | *foreground) Sets color for foreground. |
| **-font <font_name>** | (*font) Selects a different font for ***emvu*** displays. |
| **-fn <font_name>** | Same as -font. |
| **-foreground <color>** | Same as -fg. |
| **-geometry <str>** | (*geometry) Sets window size and position. "str" is in the format WIDTHxHEIGHT+XOFF+YOFF, where WIDTH and HEIGHT is the width and height of the ***emvu*** window in pixels. +XOFF places the ***emvu*** window XOFF pixels from the left edge of the screen. If you use -XOFF then the window is offset from the right edge of the screen. +YOFF places the ***emvu*** window from the top edge of the screen and -YOFF places the ***emvu*** window from the bottom edge of the screen.-For example, use "emvu -geometry 800x600-0+0" to make an ***emvu*** window of size 800 by 600 in the top left hand corner of the screen. |
| **-iconic** | (*iconic: yes)Starts ***emvu*** up as an icon. |
| **-name <str>** | (.name) Used to select a set of special defaults. See X documentation for details. |
| **-noRestoreColorMap** | (*noRestoreColorMap: yes) ***Emvu*** loads in Sonnet's color map (file name of $SONNET_DIR/data/color.pal) upon initialization and unloads the color map every time the mouse leaves the ***emvu*** window. This option prevents the color map from being unloaded when the mouse is moved out of the ***emvu*** window. |
| **-noLoadColorMap** | (*noLoadColorMap: yes) Prevents Sonnet's color map from being loaded in during ***emvu***'s initialization. |
| **-textcolor <color>** | (*textColor) Sets color of all text. |
| **-substrateColor <color>** | (*substrateColor) Sets background color for the substrate. Color is defined in the form of RRGGBB, where RRGGBB are hexadecimal numbers defining the intensity of red, green and blue. "00" is the lowest intensity and "ff" is the highest. Some examples for settings are: red - "ff0000", white - "ffffff" and black - "000000". |

| | |
|---|---|
| **-title <str>** | (*title) Sets title displayed on main window (if window can display title). Be sure to enclose entire title in quotes if it contains white space. |
| **-xrm <str>** | Provides access to the resource manager, see X window documentation. |
| **-Ver** | Prints out the current version of ***emvu*** and exits. Must be the first option on the command line. All other options are ignored. |
| **+backing** | (*backing: no) Makes sure the backing store is turned off, even if the default has been changed. |
| **+iconic** | (*iconic: no) Makes sure window comes up, not icon, even if default has been changed. |

There are several ways to specify the defaults to the ***emvu*** program:

1. Command line argument.
2. File specified by $XENVIRONMENT or if not set, the file $HOME/.Xdefaults-<hostname> is used.
3. X11 Default values already set in the window manager or by the xrdb command or, if not set, by the file $HOME/.Xdefaults. Use $HOME/.Xdefaults to set defaults on a per user basis.
4. Reads the file $APPLRESDIR/Emvu
5. Reads the file /usr/lib/X11/app-defaults/Emvu
6. Reads the file $SONNET_DIR/data/Xdefaults. Use this file to set defaults for all ***emvu*** users.

For example the following lines could be added to the $HOME/.Xdefaults file to

```
Emvu*textcolor: blue
Emvu*geometry: 980x680
```

The above file is read by ***emvu*** and sets the origin to the bottom left. Also the ***emvu*** window is started up at 980x680 size (in pixels) For other ways to control the defaults of the X Window System programs, consult the X Window System documentation.

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## I



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